All contributions to be sent to the Editor, 57 Church Street, Old Isleworth, Middlesex. (Telephone, Hounslow 0391.)

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EDITORIAL

THE great storm referred to in Dr. Davison's article was, says Lecky, "The origin of one of the most horrible of the many horrible Scotch trials on record." One Dr. Fian was suspected of having aroused the wind, and a confession was wrung from him by torture which, however, he almost immediately retracted. Every form of torture was in vain employed to vanquish his obduracy. The bones of his legs were broken into small pieces in the boot. All the torments that Scottish law knew of were successively applied. At last the king (who personally presided over the tortures) suggested a new and more horrible device. The prisoner, who had been removed during the deliberation, was brought in and (according to the contemporary narrative) "his nailes upon all his fingers were riven and pulled off with an instrument called in Scottish a turkas, which in England wee call a payre of pincers, and under everie nayle there was thrust in two needles over, even up to the heads." However, notwithstanding all this, "so deeply had the devil entered into his heart, that hee utterly denied all that which he before avouched" and he was burnt unconfessed.

It is interesting to note that in the eighteenth count of the indictment the agony of childbirth is referred to as "Your natural and kindly pain". This idea of the beneficial nature of pain was still held by many in the late Victorian era. A lady dying of cancer with periods of great pain refused to

allow the doctor to give her morphia on the grounds that God had sent her the pain and so meant her to bear it.

. . . . .

WE regret that we are unable to print in this issue the fifth in our series, " Eminent Anæsthetists ". This biographical sketch is being written by Mr. Marston who, through illness, was unfortunately unable to complete it in time. We tender to him our sincere wishes that he will have a speedy recovery and we hope to include his paper on Sir Francis Shipway in October.

THE SCOTTISH SOCIETY OF ANÆSTHETISTS

THE SCOTTISH SOCIETY OF ANAESTHETISTS met for a two-day visit at Dunblane Hydro Hotel on April 29 and 30. Dr. John Gillies, C.V.O., M.C., who was Vice-President of the Society for 1939 when the Society's activities were suspended, was elected President. Dr. H. H. Pinkerton was elected Vice-President, and Dr. R. N. Sinclair elected Hon. Secretary and Treasurer. The following Representatives to the Executive Committee were elected: Dr. Sheina Watters (Edinburgh), Dr. Leslie Morrison (Edinburgh), Dr. J. M. Campbell Dewar (Glasgow), Dr. T. T. Stacker (Glasgow), Dr. T. O. Robson (Aberdeen), and Dr. Wm. Shearer (Dundee). The Society has now just over one hundred members.

Dr. Gillies delivered his Presidential Address on " Anæsthetics as a Speciality—Past, Present and Future." Various social activities among members and their wives followed. The occasion was much enjoyed, and plans were discussed for the future of the Society, both academic and social.

The address of the Hon. Secretary and Treasurer is 31, Pollock Road, Bearsden, near Glasgow.

ANÆSTHESIA FOR ACUTE INTESTINAL OBSTRUCTION*

By JOHN W. DUNDEE

ALMOST a century ago John Snow (1853) described 19 cases of operation for strangulated hernia in which the anæsthetic used was chloroform. For the next fifty years ether, in spite of its increasing popularity, was considered to be contra-indicated in these cases (Buxton, 1888) and chloroform remained the drug of choice for acute intestinal obstruction (Hewitt, 1893). The virtue of chloroform in all cases was attributed to the quiet respiration it produced. With the introduction of spinal analgesia, and the discovery of procaine for local infiltration, general anæsthesia was used less and less for seriously ill cases. The opinion is held (James, 1944) that such cases stand a better chance of recovery if a general anæsthetic, no matter how light, is avoided altogether, and regional analgesia is recommended for elderly patients with strangulated hernia (Gillies, 1947). Spinal block will provide the quiet respiration to which chloroform owed its popularity (McGavin, 1911) but deaths have been reported in cases of operation for acute intestinal obstruction in which it has been used (Lake, 1933), due to marked fall in blood-pressure. Where the intercostal muscles are paralysed by high spinal block, expulsion of fluid from the pharynx becomes difficult (Howard-Jones, 1933), and the endotracheal technique with gauze pack or inflated cuff is considered safer (Hewer, 1948) because less

* A Paper read before the Liverpool Society of Anæsthetists, March 26, 1950.

fall in blood-pressure occurs and aspiration of vomitus is avoided.

This is a report of 100 consecutive unselected cases of operation for acute intestinal obstruction, in which all commonly used anæsthetic agents were employed in an attempt to find that which was best suited to all cases.

Figure 1 and Table I show the age distribution and preoperative clinical findings in the series.

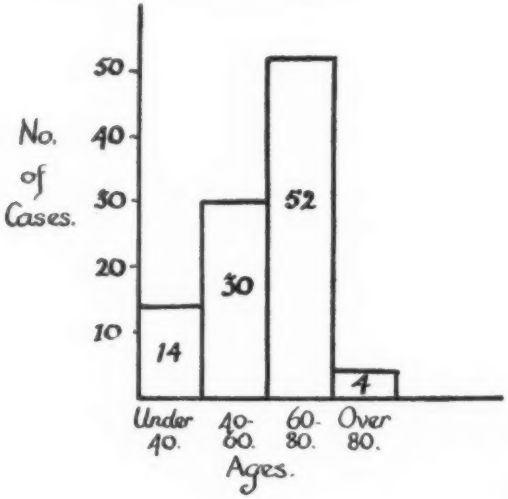

FIG. 1
Diagrammatic representation of the ages of the patients in the present series.

Comments on Table I. Vomiting varied in duration between 12 hours and 6 days, with 48 hours as average.

The incidence of cases with concurrent pulmonary disease was 37 per cent, while 45 per cent had some cardiovascular disease (excluding blood-pressure anomalies) which could be detected clinically; no electrocardiograms were taken.

The high percentage of blood-pressure anomalies is not surprising considering the mean age of the patients in the whole series, 67 years.

TABLE I

Pre-operative condition of patients

	Per cent
Operations within previous 3 weeks	11
Neoplasms 5 Appendicitis 3	
Ruptured bladder 1 Purely coincidental 2	
Vomiting (50 per cent of these fæculent)	64
Concurrent Pathology	
Pulmonary:	
Chronic bronchitis and emphysema	25
Pulmonary tuberculosis	7
Atelectasis from previous operation	3
Neoplasm of bronchus	1
Pneumokoniosis	1
Cardiovascular:	
Some irregularity in pulse	21
Tachycardia (over 120/min.)	14
Some degree of heart failure (5 of these were cyanosed)	8
Auricular fibrillation	2
Angina of effort	2
Hæmoglobin (estimated in 32 cases) under 65 per cent ...	25
Blood-pressure (recorded in only 50 cases)	
Hypertension (systolic = 100 + age/2 as normal) ...	56
Hypotension (systolic under 100 mm. Hg)	16
Grossly emaciated	20
Blind	4
Diabetes	2

The hæmoglobin figures are misleading since it was estimated only in patients who appeared to be anæmic.

Excluding hypertension, chronic bronchitis and diabetes, 66 of the cases had some concurrent pathology which would have been treated before subjecting them to elective surgery.

In Table II are shown the causes of obstruction.

In Figure 2 is shown the distribution of operating times.

TABLE II

Causes of obstruction

	Per cent		Per cent
Neoplasms	35	Herniæ	33
Adhesions	11	Volvulus	7
Diverticulitis	5	Gall stone ileus	2
Others	7 per cent		

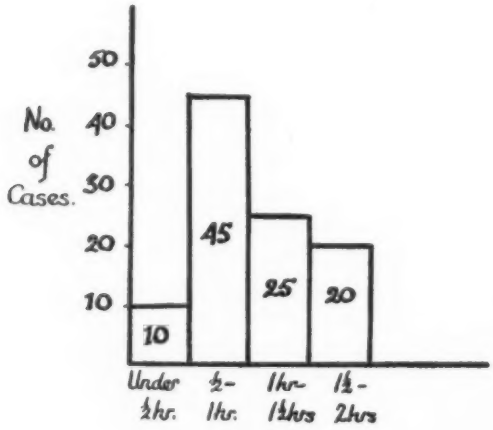

FIG. 2

Diagrammatic representation of the duration of operation in the present series.

The average operating time was 55 minutes. This can partly be explained by the fact that 62 per cent of the operations were performed by registrars and in 36 per cent of the cases the surgeons were relatively inexperienced.

Fæcal vomiting was correlated with a high death-rate. Ten of the total number of deaths occurred among the 32 cases who had this sign. In only three instances could death be attributed to anæsthetic technique.

The 19 per cent mortality (see Table IV) compares closely with the 21 per cent in the series described a century ago by Snow (1853). But it should be remembered that more seriously ill patients than was the case a century ago are now given—what is to them the only hope of recovery —surgical treatment.

TABLE III

Post-operative complications

	Per cent		Per cent
Major Respiratory ...	17	Cardiac Failure	9
Burst Abdomen	8	Thromboses	6
Mental Deterioration ...	4	Uræmia	2
Delayed Chloroform Poisoning		1 per cent	

TABLE IV

Mortality and causes

	Per cent
Deaths within first 10 days	19
Deaths without gaining consciousness	4
Causes of death:	
Peritonitis (8)	45
Pulmonary Embolism (2)	10
Cardiac Failure (2)	10
Atelectasis (2)	10
Others (5)	25

PRE-OPERATIVE PREPARATION

Most of the cases suffered some degree of dehydration due to vomiting. These were assumed to be in a state of salt depletion of the mixed type (Marriott, 1947), varying with the duration and intensity of the vomiting, and attempts were made to correct this in the short time available between admission to hospital and the operation. Patients with a high obstruction, e.g. pyloric stenosis, lose a fluid which is predominantly acid, leading to lowered plasma chloride, a

relative increase in plasma base, and therefore alkalosis; while in regurgitated intestinal contents due to a low obstruction, large quantities of chloride and especially base are lost, which may lead to acidosis. As gastric juice contains 3.3 g. sodium chloride per litre and intestinal contents 5.7 g. sodium chloride per litre (Coller and Maddock, 1940) irrespective of the site of obstruction, normal saline containing 9 g. sodium chloride per litre can correct the loss, and is the fluid generally used. The above authors give a rule for correction of salt imbalance, viz., " For every 100 mg. that the plasma chloride level needs to be raised to normal (560 mg. per cent), give 0.5 g. sodium chloride per kilogram body weight." This may be a very useful rule for non-emergency cases, but in practice the plasma chloride estimation requires skilled laboratory technicians who are rarely available at night, when most cases of intestinal obstruction are admitted. In every case in this series in which it was tried, the operation was over before the plasma chlorides were estimated. Urinary chloride estimation (Fantus, 1936), on the other hand, is a comparatively simple matter, only requiring simple apparatus, and can be done in a few minutes. Interpretation of the results is difficult, because allowance must be made for the concentration of the urine due to vomiting and fluid loss. It must be accepted, however, that cases with complete absence of chloride in the urine are grossly deficient in sodium chloride. No chloride was detected in the urine of 7 out of 10 cases in this series in whom the urinary chlorides were estimated. Fifty per cent of all cases had normal saline intravenously either before or during operation, or both. In cases of prolonged vomiting, one litre of saline was given before operation and in less severe cases it was started during the operation. With this technique the dangers of giving an

excess of salt, e.g. pulmonary œdema, are very small, and it proved very satisfactory in practice. Only when there was complete absence of chloride from the urine was it considered justifiable to postpone operation to allow for intravenous therapy. Correction of the dehydration makes the urinary chloride estimation more reliable post-operatively, and here it was used extensively and normal saline or 5 per cent glucose given as required.

Blood was only given to five cases, in three instances for severe anæmia, and in two cases with gangrene of the gut. This latter is likened to a massive internal hæmorrhage (Boyd, 1947; Illingworth and Dick, 1949) and inadequate transfusion may have been the explanation of two cases of death that occurred. In neither instance was the gangrenous condition diagnosed before operation, and both patients appeared to be reasonably fit. Induction in both cases was with 0.5 g. of 5 per cent thiopentone and in both cases this produced profound anæsthesia from which neither case regained consciousness. Death occurred two hours and eight hours respectively after operation. This prolonged action of thiopentone appears similar to that described by Halford (1943) after the Japanese air-raid on Pearl Harbour in 1941.

Plasma was given to 10 cases, and in most instances it was found to be an effective treatment for shock, where there was no severe blood-loss. In a few cases it was used because blood was not available.

Intravenous digoxin 0.5 mg. was given to 12 cases before or during operation and was very effective in reducing the pulse-rate in severe tachycardia. It was given in cases where the pulse-rate was over 120 per minute; it was not given to patients already digitalised.

Oxygen inhalation pre-operatively was given to several

cases, with a view to decreasing the abdominal distension (Macintosh and Mushin, 1946), and in most cases the effect was disappointing, probably due to the short duration of inhalation and inadequate technique of administration. In 2 cases, however, a remarkable decrease in distension occurred after two or three hours of therapy, 6 litres per minute being given by nasal catheter.

ANAESTHETIC TECHNIQUE

Eighty per cent of cases had general anæsthesia, 11 per cent had spinal, and 9 per cent local analgesia.

Spinal. The high incidence (72 per cent) of blood-pressure anomalies, often associated with arteriosclerosis (Evans, 1949), and such factors as cardiac failure and history of angina (Mushin, 1948) made most cases unsuitable for spinal block. Four out of 11 cases had a severe fall of blood-pressure, and 2 of these vomited during handling of the gut. In 1 case of strangulated hernia the mass disappeared following the spinal, necessitating a lower paramedian incision to examine the gut and perform a resection. Death occurred 4 days later from peritonitis. Had the ruptured gangrenous loop of bowel not entered the general peritoneal cavity following the spinal, this patient might have survived.

Local. In all 9 cases a paravertebral block (Labat, 1923) was performed using amethocaine 1 : 2,000, procaine 1 : 200 and adrenaline 1 : 250,000. All the blocks were successful but they were time-consuming and several patients objected to being turned on their side and appeared to be hyper-æsthetic to needle pricks. Three patients requested to be put to sleep. Two cases are worthy of mention; both were very ill patients over 80 years of age with strangulated herniæ. A unilateral block of T 11 to L 12 was sufficient

for repair of the hernia and was probably the only form of anæsthetic which they would have survived.

General. While local and spinal analgesia have the advantage of retaining an active cough-reflex in patients with a full stomach, general anæsthesia has been found to be most acceptable to both surgeon and patient. Two methods are recommended for control of regurgitation of intestinal contents which frequently occurs when consciousness is lost. A full-sized stomach tube can be passed before induction and maintained in position throughout (Guedel, 1937; Galley, 1949; Minnitt and Gillies, 1948) or a Ryle's tube with continuous suction can be relied upon until consciousness is lost when a stomach tube is passed (Hewer, 1948). Both methods were tried. As can be seen from Table V, the use of a stomach tube throughout is the only safe method and it is believed that a Ryle's tube gives a false sense of security.

TABLE V

Control of regurgitation of intestinal contents

1. Ryle's tube	42 cases
Regurgitated or vomited	15 cases* (36 per cent)
2. Stomach tube	20 cases
Caused trouble	1 case (5 per cent)

* Nine of these during induction.

It was found that pharyngeal suction was very essential during removal of the stomach tube, as it often left a pool of fæculent fluid behind it. Intubation with a cuffed tube under topical analgesia before induction of anæsthesia was tried in a few cases but this was time-consuming and often distressing to the patient.

The use of a stomach tube made endotracheal intubation a necessity, as no face mask was available with an opening for such a tube. Fifty-four out of 80 cases were intubated orally; the presence of a stomach tube did not make intubation any more difficult. A closer watch could be kept on the patient's condition and such things as the intravenous drip attended to without having continually to support the jaw. In two-thirds of the intubated cases a cuffed tube was used. In 3 such cases, who subsequently regurgitated, no fluid was found in the tracheo-bronchial tree on examination (2 at autopsy and 1 at bronchoscopy), whereas 1 case who vomited, when a plain tube was used, subsequently developed a lung abscess. This is in agreement with the accepted view as to the added safety of a cuffed tube.

Anæsthetic Agents. All commonly used agents were tried. The only case to whom chloroform was administered developed jaundice and pernicious vomiting on the third post-operative day, followed by mental confusion. Recovery followed massive doses of glucose and calcium. In obstetrics delayed chloroform poisoning is more frequent in patients with hyperemesis and acidosis, and following vomiting the liver appears to be unduly susceptible to chloroform (Sheehan, 1940). This patient had been vomiting intermittently for 48 hours and had no pre-operative glucose. Likewise, experiences with trichlorethylene have not been at all happy. As has been reported (Hewer, 1942) relaxation could not be guaranteed, and, when the dose was increased, troublesome tachypnœa occurred, necessitating a change to ether.

Apart from the 2 cases previously mentioned, no trouble was encountered with thiopentone as an induction agent, very small doses being required. A 2½ per cent solution was preferred to 5 per cent. In cachectic, anæmic and toxic

patients its effect was generally more prolonged than normally. Towards the end of the series, induction with thiopentone was adopted as a routine as soon as possible after the stomach tube was passed, because this reduced to a minimum the discomfort caused by the large-bore tube. Very few of the cases in whom this method was used remembered the tube being passed, suggesting a brief period of retrograde amnesia. Nitrous oxide—oxygen—ether (or "V.A.M.") or cyclopropane and oxygen were all reliable for maintenance, and the use of curare permitted minimal doses to be used. The closed circuit was preferred to the semi-open technique.

Because of the distended gut, profound muscular relaxation was essential for a proper exploration of the abdomen, and more especially for closure of the peritoneum. In several cases, where muscle relaxants were not used, adequate relaxation could be produced only by a dosage which caused such severe respiratory depression that cyanosis occurred. Relaxants were used in 42 cases (curare in 38, decamethonium iodide in 2, Myanesin in 2). Myanesin was found to be of no value. The average dose of d-tubocurarine chloride to produce good operating conditions was 18 mg. This is a small dose considering the average duration of operation. It was not surprising, however, when it is remembered that the average age of these patients was 67 years, as it is recognized that the elderly require considerably less relaxant drug (Gray, 1947). Cyclopropane was used during closure of the peritoneum in order to avoid giving more curare; it has the advantage of quick excretion and rapid return of cough-reflex.

Pannett's peritoneum forceps (Pannett, 1920) which were used in one hospital were a great help for closure of the peritoneum. Burst abdomen is now attributed to protein

depletion and not to ineffective suturing, but had better relaxation been produced for closure, the high incidence (8 per cent, Table III) of this complication might have been reduced.

During the operation, where there was a fall of blood-pressure due to traction on the mesentery, Methedrine 10–15 mg. intravenously with 10–15 mg. intramuscularly was effective in raising the pressure to normal (Dodd and Prescott, 1943), and in most cases the rise was maintained. No post-operative excitement was seen following its use.

CONCLUSIONS

As with any other procedure, each case must be considered individually, but the following routine is now adopted as the result of experience in this series of cases. A saline drip is set up and $\frac{1}{2}$–1 litre given as required, and 1/100 gr. (0.65 mg.) atropine with or without morphine administered intravenously. If at all possible the patient is anæsthetized on the operating table where Trendelenburg tilt can be adopted when required and suction is available. A liberal amount of liquid paraffin or glycerine is poured over the back of the patient's tongue, and 5 mg. d-tubocurarine chloride given intravenously. While this is having effect a full-sized stomach tube is passed. In tough patients this manœuvre is made much easier by the small dose of curare. Two-and-a-half per cent thiopentone is given slowly into the drip as soon as possible after passage of the stomach tube, to minimize discomfort to the patient, but should be withheld until drainage from the stomach is complete. After inflating the patient with oxygen it may be possible to do an oral intubation with a cuffed tube, but more curare or thiopentone may be required. There need

be no hurry to do this when the stomach tube is in place. After direct union to a closed circuit machine, 1 litre each of nitrous oxide and oxygen is given with minimal ether for maintenance and curare as required. The respiration is always assisted. Cyclopropane is added for closure of the peritoneum, and breaking the table may assist in this. Special care must be taken when removing the stomach tube, and the pharynx should be sucked out after its removal. The endotracheal tube is not removed until the pharyngeal toilet is complete. Atropine 1/50 gr. (1.3 mg.) is given into the drip as the peritoneum is closed, followed by intermittent doses of neostigmine up to a maximum of 5 mg., until there is a normal tidal respiratory excursion.

SUMMARY

Anæsthesia is discussed for 100 unselected consecutive cases of acute intestinal obstruction.

General anæsthesia has proved the most satisfactory method, with a stomach tube and cuffed endotracheal tube to control vomitus.

I wish to express my thanks to Drs. T. Cecil Gray and John B. Hargreaves for their encouragement and advice in preparing this paper, and to the surgeons and registrars of Walton Hospital, Liverpool, and the City and County Hospital, Londonderry, in allowing me to try the various techniques described.

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ANÆSTHESIA IN OPERATIONS FOR ACUTE INTESTINAL OBSTRUCTION

By F. L. ROBERTSHAW

OPERATIONS for the relief of acute intestinal obstruction present the anæsthetist with a variety of problems if the patient is to be safeguarded, and the work of the surgeon assisted by good operating conditions. Perhaps because it usually falls to the lot of residents to give these anæsthetics, comparatively little has been written on the subject in recent years.

The patients are often poor anæsthetic and operative risks, especially in a hospital which receives cases from a large country area. When they have been vomiting for some time, especially in the presence of a high obstruction, they suffer from a loss of fluids and chlorides, and present a toxic appearance, with hollow cheeks and sunken eyes. In the more severe cases there may be delirium. These patients are especially liable to vomit actively, or passively during induction of anæsthesia, with the risk of inhaling liquid fæcal vomit. The danger lies not merely in the fact of vomiting, but in the unusually large volume of fluid, which may make the usual safeguards quite inadequate. From the surgeon's standpoint, the extreme distension of the bowels which may be present makes really good relaxation and a " quiet abdomen " essential.

Deep general anæsthesia has little to recommend it for these patients. As an alternative, the use of spinal anæsthesia has been recommended in the absence of too great a degree of shock (Paterson Brown, 1943; Minnitt and Gillies, 1944).

But it is contra-indicated in seriously ill patients, and a case has been reported by Lake (1933) in which death, due to inhaled vomit, occurred following an operation under spinal anæsthesia with one of the longer-acting drugs. It was then pointed out by Howard-Jones (1933) that spinal anæsthesia, though it does not interfere with the protective reflexes of the pharynx, may still interfere with the normal act of vomiting, by paralysis of the abdominal musculature and a varying number of intercostals, so that a patient with copious vomiting is unable to eject with sufficient force to clear the pharynx, and thereby avoid aspiration of dangerous amounts of fluid into his bronchial tree. The other alternative is to use a regional nerve block. This can give excellent results, but is tedious and exacting to induce, and is perhaps too seldom used.

To-day, the use of curare, or other relaxant, with light general anæsthesia is probably the method of my choice in most cases. The patient benefits from the use of minimal doses of anæsthetic agents, and the surgeon is enabled to complete his work under favourable operating conditions. Nevertheless, the method is not without danger. The relaxation produced by curare greatly increases the risk of passive regurgitation of large amounts of fluid through the œsophagus. I have seen this happen on a number of occasions in cases of obstruction, and also, somewhat unexpectedly, in cases diagnosed as perforated peptic ulcer. The technique to be described has been found successful in these cases.

TECHNIQUE

The patient is prepared in the ward as usual, and a small stomach tube is used to aspirate stomach contents. It should be left in position until the patient recovers consciousness

after the operation. Aspiration should be repeated at fairly frequent intervals, especially just before the induction of anæsthesia. In high obstructions, and where the patient is dehydrated, an intravenous drip should be given to restore water and electrolyte balance. Light premedication, usually morphine gr. 1/6 (10 mg.) and atropine gr. 1/100 (0.65 mg.) is given, preferably one hour before operation.

In the anæsthetic room, everything required, including an efficient suction apparatus, must be to hand before starting, as the induction must be carried through without interruption. Five milligrams of curare (tubocurarine chloride) is given intravenously, followed by the usual pause to detect any hypersusceptibility (Gray and Halton, 1948); then the remainder of the dose, usually totalling 15 mg., is given, followed at once by an induction dose of thiopentone, usually 0.5 g. (More recently, as an alternative, 100 mg. of Flaxedil mixed with 0.5 g. thiopentone has been found most satisfactory.) Anæsthesia and relaxation follow, with a short period of apnœa, during which the largest practicable size of cuffed Magill tube is passed under direct vision with a laryngoscope. Even at this time some regurgitation may be seen and should be dealt with by suction. The cuff is inflated and anæsthesia continued, usually with light cyclopropane, or alternatively nitrous oxide and oxygen with minimal trichlorethylene as described by Ostlere (1947, 1948). Most patients breathe spontaneously from the time they are connected to the anæsthetic apparatus, but some assistance to respiration is usually required. Even though oxygenation may be adequate with shallow breathing, care must be taken to assure adequate ventilation, to eliminate carbon dioxide (Organe, 1946). Small doses of curare (or Flaxedil) may need to be given to maintain relaxation until the abdomen is closed, but often

the initial dose suffices. Pharyngeal reflexes are allowed to recover, and the pharynx inspected and aspirated before the endotracheal tube is removed.

DISCUSSION

The method described provides a safe and rapid induction, followed by good operating conditions. It safeguards the patient against inhaling vomit, since a period of apnœa follows the injections, during which intubation with a cuffed tube is easily and rapidly accomplished. In any case, the pharynx is observed by means of a laryngoscope from the time consciousness is lost, and suction can be applied at once to any fluid seen in the pharynx.

Needless to say the doses used are adapted to the patient. However, too great caution in this matter should be avoided, since it will lead to difficulty and perhaps delay in intubation. Slight overdose can, of course, be dealt with by manual compression of the rebreathing bag, once the endotracheal tube is safely in place. Reflexes should return promptly at the end of the operation, and this is probably more easily ensured with inhalation anæsthetics than if larger doses of thiopentone are used as supplements to nitrous oxide and oxygen.

Care should be taken that the patient is not returned to the ward curarized, or he may still risk aspiration. If necessary neostigmine 3 to 5 mg. should be given to reverse the action of curare (or Flaxedil). It has been found useful on a number of occasions, but not as a routine (Gray and Halton, 1946).

SUMMARY

The problems of anæsthesia for cases of acute intestinal obstruction are outlined, and various methods considered.

The danger of using curare for these cases without careful precautions is pointed out, and a suitable technique described.

Thanks are due to Mr. J. A. Simpson, F.R.C.S., for his co-operation and criticisms.

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PRELIMINARY REPORT ON A NEW TECHNIQUE FOR EPIDURAL ANÆSTHESIA

By A. IKLÉ

EPIDURAL or peridural anæsthesia has lately gained many adherents. Brunner (1949) says: " The method is suitable for gynæcological operations since it has the advantages of spinal anæsthesia without its dangers or disadvantages." Anselmino (1944) considered the method to be valuable because it offered new possibilities of relieving labour pains by a prolonged block.

The technique has recently been improved and new anæsthetic solutions have been introduced.

On the continent, Dogliotti's (1933) technique of maintaining pressure on the piston of a syringe attached to the needle has become prevalent. The transition from the ligaments to the epidural space can be fairly exactly determined by steady pressure on the piston, owing to the fact that the interspinous ligaments offer considerable resistance to injection, whereas that offered by the epidural space is very slight, or actually negative.

In America another technique is often used which is based on the slight negative pressure of the epidural space. A small capillary glass tube containing a bubble is attached to the hub of the needle. The sudden forward movement of the bubble signals puncture of the epidural space.

We have developed a technique, based on Dogliotti's principle, which seems to us very feasible, and which has gained adherents. This technique is easier to learn and safer than the older methods. It provides an especially good

safeguard against erroneous spinal injection, which is the main danger with which the inexperienced have to contend.

With this technique we have anæsthetized over 250 gynæcological and about 75 obstetric cases with no failures; so that it seems worth while to give a detailed account of the method.

Premedication. Patients are generally given a combination of scopolamine, morphine and ephedrine one hour before operation. For more frail patients Dilaudid-atropine is preferred.

Technique of anæsthesia. The inexperienced anæsthetist will find his first attempts easier if the patient is in the sitting position. This facilitates anatomical orientation and allows of symmetrical palpation. It is very convenient for the patient sitting on the operating table to lean upon a simple, adjustable stand, such as that illustrated in Figure 1.

With some practice the injection may be easily made with the patient in the lateral position.

It is a great advantage to acquire an appreciation of the feel of the different tissues penetrated by making injections first in the cadaver.

We prefer the left lateral position: very good relaxation is more important than flexion of the spine. Occasionally for very sensitive and nervous patients a few millilitres of a barbiturate such as thiopentone, Kemithal or hexobarbitone may be injected intravenously, so that they will be unaware of the whole proceeding.

After preparation of the skin the position of the spinous processes is determined by palpation, and a spinal interspace is chosen for the puncture at a level corresponding to the area of the operation. If no suitable interspace can

be found within the desired zone (as indicated by the segmental innervation of the trunk) it is always permissible to puncture somewhat higher or lower.

With a fine and fairly long needle the skin and subcutaneous tissue is infiltrated with local anæsthetic and this opportunity is utilized to make sure that the chosen space can be pierced by the needle. The subdural space should not, of course, be punctured. If this should happen by mistake it will not be of serious consequence, thanks to the very small calibre of the needle; and it is permissible to continue with the epidural injection. However, the incidence of headache and pains in the neck does seem to be increased in these cases.

With a sharp knife a small incision in the skin is now made in the anæsthetized wheal. The special epidural puncture needle is then inserted exactly in the median line and pushed forward to a depth of 3 to 5 cm. It meets fairly firm resistance in the ligamentum flavum or, lower down, in the interspinous ligaments (Fig. 2). The needle contains a stilette and has two lateral wings. These give perfect control of the needle with the hand supported on the patient's back. For small, thin patients we use a somewhat shorter (6.5 cm.) needle; for big, obese women a 7.8 cm. needle.

As soon as the needle is firmly gripped by the ligament the stilette is removed and the special spring-loaded syringe is attached (Fig. 3). This syringe should have previously been filled with 3.5 ml. of normal saline solution. This operation serves also as a check that the syringe is working properly. The piston is kept in the " up " position with the spring compressed by turning the plunger, which is fitted with a bayonet catch, through 90 degrees.

When the " cocked " syringe has been firmly attached to

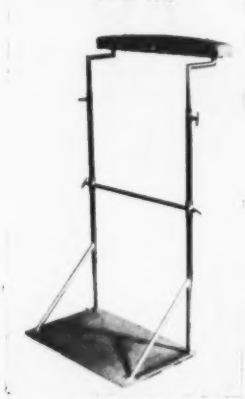

FIG. 1

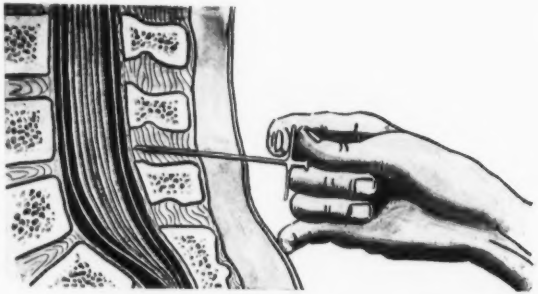

FIG. 2

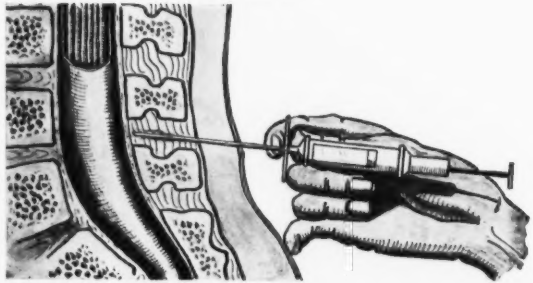

FIG. 3

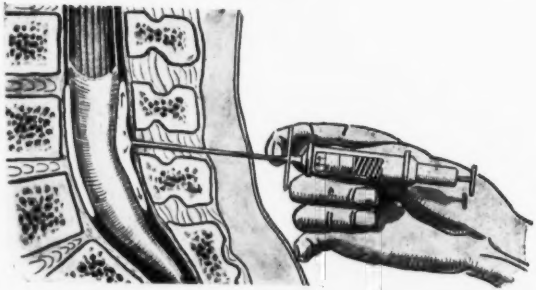

FIG. 4

the needle, the plunger is turned back through 90 degrees, releasing the bayonet catch. The spring is then prevented from discharging the contents of the syringe only by the ligaments.

The needle is then pushed carefully, with a uniform motion, through the ligaments. The two wings of the needle should be held between the thumb and index finger of each hand, so that the lateral part of the hand, and especially the little finger, rests on the patient's back (Fig. 3). As soon as the needle-point penetrates the epidural space the spring squirts the saline solution into it. The dura remains undamaged because the pressure of the fluid pushes it away from the needle-point (Fig. 4).

The empty syringe is now removed. Care is taken that no cerebrospinal fluid comes out of the needle. Occasionally a few drops of saline drop from the end of the needle: this, of course, is of no significance. If there is any doubt, however, one can aspirate with a 5-ml. syringe, rotate the needle a little, re-inject some saline and aspirate again.

The anæsthetic solution is then slowly injected, with a preliminary test dose. This ensures that even if the injection should be intrathecal it would not have serious consequences. One should wait for seven minutes and verify that no anæsthesia and no general reaction has occurred within this time. Further doses are then given according to the drug selected and the extent of anæsthesia desired. We use Pantocaine (amethocaine) solution made up in ampoules by the German pharmaceutical firm of Hoechst. Generally sufficient anæsthesia may be obtained with 15 to 20 ml. of the water-soluble preparation or 10 to 15 ml. of Periston Pantocaine solution. Untoward blood-pressure reactions have not been seen. It is necessary, nevertheless, to adapt the dose individually to the patient's

constitution. One soon learns to estimate the required amount by using fractional doses and allowing plenty of time.

When the anæsthetic has been injected the needle may be removed. The punctured site is cleaned with antiseptic and the patient placed comfortably on her back. A blood-pressure reading will indicate whether any pressor agent is required. Small doses of Cardiazol-ephedrine, Ephedraline or Methedrine, repeated if necessary, have proved very valuable. The extent and intensity of anæsthesia can be ascertained by pinching the skin. The operation should not start earlier than twenty minutes after the end of the injection. If a serious blood-pressure fall should unexpectedly develop, one is in a better position to deal with it than if the operation is already in progress.

Supplementary general narcosis. For minor operations additional anæsthesia is usually unnecessary. Omnopon-scopolamine or similar drugs are often given intravenously at the start of the operation. The patient should always awake at the end of the operation. In many cases light nitrous oxide anæsthesia has been found suitable, if necessary combined with thiopentone added just before the most painful parts of the operation. Anæsthesia lasts for fully three hours; hence it suffices even for very long operations without an additional injection being required.

Using a similar technique a catheter may be introduced for continuous epidural anæsthesia. For this purpose needles of somewhat larger calibre are used, with a curved point after the American pattern (Huber point). The calibre of the needle is such that the finest American nylon catheters (16 gauge) may be easily inserted. The needle is withdrawn over the in-dwelling catheter, and the catheter is then connected to the anæsthetic solution container by

means of an adapter and rubber tube. In this way a continuous epidural anæsthesia of any desired duration may be administered.

The syringe and needle (Fig. 5) are made by Ulrich & Co., Sanitätsgeschäft, St. Gall, Switzerland.

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GENERAL ANÆSTHESIA FOR DENTAL SURGERY IN INCREASED RISK CASES

By L. A. GIFFORD

THIS account describes a method of general anæsthesia which has proved very useful in those increased risk cases requiring dental surgery, who are unsuited to local or regional anæsthesia by reason of oral sepsis, of widespread caries, or of temperament. Such are some with neglected mouths needing attention as part of the treatment of bronchiectasis, myocarditis or nephritis, chronic cases such as disseminated sclerosis, and antenatal cases who are late in seeking oral hygiene.

The risks in mind are not only those to life, but also liability to post-anæsthetic complications and to relapse or increase of disease.

PREPARATION

For these people it has been found wise to use the theatre table rather than the dental chair, in order to favour cerebral circulation in the feeble and to allow the anæsthetist better access during the induction. The supine position makes necessary very full precautions against the inhalation of dental fragments or vomitus, which are more easily controlled when cases are seated.

Fragments are kept away from the glottis by packing the throat; but empty stomachs must be ensured by admission of patients at least four hours before the extractions, and by giving intravenous glucose when diabetics require a substitute for lunch.

Premedication. As the patients are warded, premedication can be used. Morphia gives both courage and analgesia, but dosage must not exceed grain $\frac{1}{6}$ (10 mg.) so that breath-holding and laryngeal spasm are not invoked. Atropine grain 1/100 (0.6 mg.) should be given, to prevent salivary flooding of the structures the surgeon wishes to handle, and to allow the use of adjuvant volatile anæsthetics at will. The latter freedom during maintenance of anæsthesia is rarely exercised, but is necessary if the intravenous induction is to be accomplished with " the least that may do well " and not " a little more to be sure ". Premedication is timed for one hour before operation.

ANAESTHETIC TECHNIQUE

There remains the problem of providing full scope for the surgeon, with good packing of the fauces, while giving only small amounts of non-injurious drugs. This is done by the following technique.

Induction is with Kemithal Sodium (sodium allyl cyclohexenyl thio-barbiturate), using two-thirds to three-quarters of the dose the administrator would give if planning a simple sequence of Kemithal and nitrous oxide with oxygen. This measure often results in an injection of 6 cc. of 10 per cent solution of Kemithal (0.6 gm.).

Through the same needle is given an intravenous dose of paraldehyde, 8 per cent solution in sterile pyrogen-free water. Dosage is of the order of 0.8 to 1.4 ml. of pure paraldehyde (10 to 17.5 ml. of 8 per cent solution).

By this sequence we have intravenous sedation with the early advantages of Kemithal induction, and for a period the advantages of paraldehyde basal premedication; yet the sedation is of useful depth for no more than ten to fifteen

minutes, if maintained only by a permissible strength of nitrous oxide.

Inhalation of nitrous oxide, never exceeding 80 per cent of the gas with 20 per cent oxygen, is commenced immediately after the intravenous injections. Within one minute, an oiled Magill endotracheal catheter cut to 6½ inches is introduced through the nose into the pharynx. The gas mixture is now supplied through this tube while the mouth and other nostril are held closed. The gaseous system used is the semi-closed, with a lightly loaded expiratory valve.

After a further half-minute, the dental gag is applied to protect the fingers while the upper oropharynx and fauces are thoroughly packed with folded moistened gauze. The next breaths are closely observed while adjustments of the nasal tube are made to ensure that the pack does not partly overlie the bevelled end, which should be above and near the glottis.

A completely free airway is secured in almost all cases, and when this is so, we have perfect conditions for dental surgery for at least ten minutes. The head may be raised a long way to suit temporary surgical need.

RECOVERY

At the end of operation, enough hands are found for steady lifting of the patient, and only then is the gas mixture cut off. The patient is placed in the semi-prone position before withdrawal of the pack and tube. Reflexes are now active and the patient is chewing on the wicks placed over the empty sockets. The eyes open in surprise as the tube is removed.

Later effects of the drug are seen in a quiet sleep from which the patient is easily roused by conversation or simply

taking the pulse, wakefulness being sufficient for the use of mouth-washes if these are offered. Even in peaceful surroundings, full wakefulness is usual after half an hour. Patients say they feel very well, and specific questioning is needed to reveal some haziness in the head, but gastric uneasiness is not met unless blood has been swallowed after operation. Uterine disturbance has not appeared in the pregnant cases.

Venous thrombosis has not ensued in a hundred cases having these barbiturate and paraldehyde injections, even when 10 per cent paraldehyde has been used. No form of venous compression is permitted after the venepuncture.

VARIATIONS IN TECHNIQUE FOR LONGER OR BRIEF SURGERY

When oral surgery in the debilitated is expected to continue more than ten minutes, it is sound practice to use endotracheal anæsthesia, provided that intubation is not carried out with the help of high concentrations of carbon dioxide or of topical analgesia of the glottis. Yet, in cases with marked physical handicap, it is preferable to make two short operations of the surgery and to use the endopharyngeal method. The cheerfulness with which these cases return for their second course is striking.

For very brief surgery, the ten-minute sedation is not necessary; but it can be a very good alternative to bargaining for a precise time limit, and is a safe base from which to attack a hollow tooth or buried root.

DISADVANTAGE OF THIS METHOD

It is well here to stress the disadvantage of the method in that its use in the presence of a loaded stomach would

court grave danger: the initiation of vomiting would call for very speedy removal of the pack in addition to normal countermeasures. This complication has not yet occurred with the method as here described.

The sequence of Kemithal, paraldehyde, and nitrous oxide with oxygen should not be regarded as of service only for dental work: it is another of the methods of producing stable first-plane anæsthesia, and has been used for such operations as amputation for senile gangrene.

SUMMARY

The problem is that of providing safe general anæsthesia for those poor risk cases in whom local anæsthesia for dental surgery is contra-indicated.

Preliminary rest and starvation are advised, and mild premedication, including the use of atropine.

An operating position near horizontal is used.

The main anæsthetic agent is nitrous oxide with at least 20 per cent oxygen, the mixture being delivered into the pharynx by nasal tube. Without occluding the tube, a gauze pack is inserted. In order that these should be tolerated, a stable foundation for the anæsthesia must be laid. This stability is safely brought about by Kemithal induction coupled with intravenous paraldehyde.

The danger of vomiting is stressed: it does not occur with brief fasting if the method is properly carried out.

ACKNOWLEDGEMENTS

Intravenous paraldehyde has been much used (Adams, 1944) but often as the principle anæsthetic agent (Beauchemin *et al*, 1935). Here it is presented as a most

useful adjuvant, a role which a consideration of its pharmacology (Goodman and Gilman, 1941) might lead one to expect.

I wish to express my gratitude to Mr. L. H. Pollitt, visiting Dental Surgeon to Hope Hospital, Salford, for his help and advice during the early trials of this process.

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VOLUMETRIC DETERMINATION OF ETHER OR CYCLOPROPANE, CARBON DIOXIDE, NITROUS OXIDE AND OXYGEN IN ANÆSTHETIC MIXTURES

By F. J. PRIME

DURING the course of certain investigations it became necessary to be able to analyse anæsthetic gases for their oxygen content in particular. It seemed also desirable to attempt to estimate other components of such gases.

Searching the literature, only scanty references could be found to methods of performing these analyses and such methods as were quoted were of difficult application or unreliable. Work was therefore put in hand to devise methods easy of application giving results of good accuracy and reproducibility. This paper gives an account of the method finally developed.

APPARATUS

The standard Haldane Gas Analyser is used. It is modified by the addition of a tube containing concentrated sulphuric acid which intervenes between the sodium hydroxide tube and the burette (Plate I and Fig. 1). The sulphuric acid is of high quality and specific gravity of 1.98. The sodium hydroxide and pyrogallol used to absorb CO_2 and oxygen are prepared in the following manner:

250 ml. of distilled water are placed in a 500 ml. Pyrex Erlenmeyer flask and piece by piece approximately 250 g. of solid sodium hydroxide are added, the flask being stood

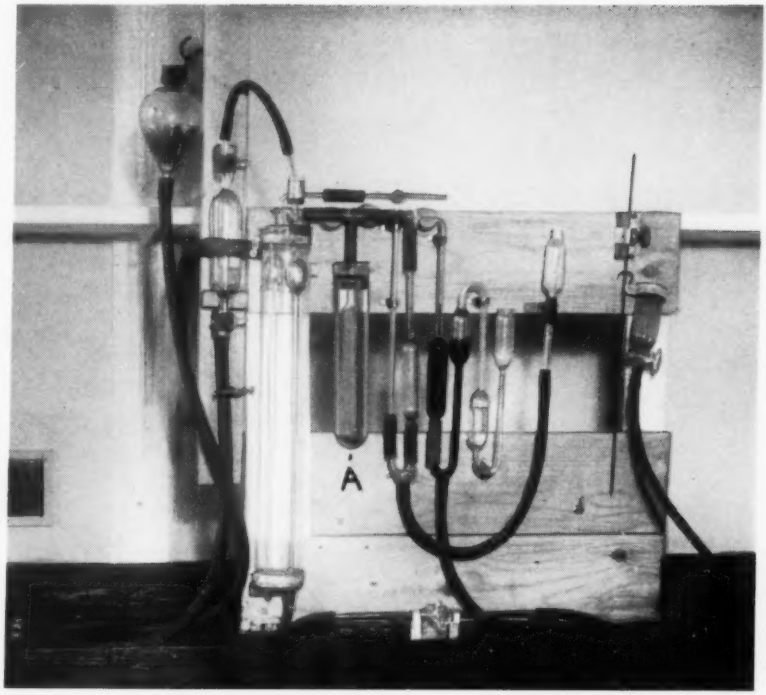
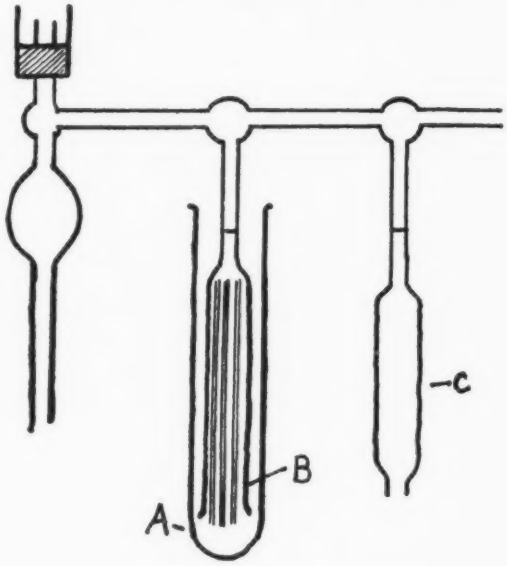


PLATE I

Haldane's apparatus with additional absorbing unit (A).

in a tank of cold water to absorb the considerable heat which is given off during the solution of the caustic soda. When all the caustic soda has been added the flask is stoppered and



A. Pyrex test-tube 8″ × 1½″.
B. Inverted funnel containing glass rods.
C. NaOH reservoir.

FIG. 1
Showing the additional absorber fitted to the Haldane Gas Analyser for absorption of ether or cyclopropane.

left to stand for 48 hours; it is occasionally shaken. If all the caustic soda dissolves, more is added until the solution is saturated and stands over a few grammes of solid caustic soda. The saturated solution is quite viscous. An appropriate amount of this solution is placed in the caustic soda

tube of the Haldane apparatus and with the remainder a supply of pyrogallol is made by adding an excess of pyrogallic acid. The resulting dark solution is kept in a securely sealed bottle for some days with occasional shaking, after which time it is placed in the oxygen-absorbing tube of the Haldane apparatus.

TABLE I

Showing the degree of absorption of N_2O in saturated NaOH, saturated alkaline pyrogallol and concentrated sulphuric acid

Original volume of N_2O ml.	Readings of volume taken after passing gas 60 times into reagent		
	NaOH	Pyrogallol	Sulphuric acid
9.280	9.281	9.280	7.520
9.480	9.481	9.480	7.682
9.331	9.330	9.331	7.540

These solutions have been found to be effective in absorbing CO_2 and oxygen respectively and have, in addition, the valuable property of *not dissolving nitrous oxide*. Table I shows successive readings of the volume of pure nitrous oxide introduced into the burette and passed repeatedly into one or other of the solutions. It will be seen that no appreciable change of volume has occurred after passage through these solutions, although absorption in sulphuric acid is marked.

METHOD

Anæsthetic gases commonly contain percentages of oxygen greater than 50 per cent. In addition, the anæsthetic agents themselves constitute the greater part of the residual gas after removal of oxygen; the volume of unabsorbable gas, i.e. nitrogen, may thus be very low indeed. It is there-

fore necessary to employ a "nitrogen dilution method". That described by Haldane (1935) is fairly accurate, but has the disadvantage that only 3 ml. of gas to be analysed can be used. The following method whereby volumes of gas up to 10 ml. may be used has been tested and found to give uniform results, which are quoted in Tables II and III.

TABLE II

Replicate analyses of samples of gas containing Ether, CO_2 and Oxygen

Ether per cent	CO_2 per cent	Oxygen per cent	Ether per cent	CO_2 per cent	Oxygen per cent
13.10	2.10	68.20	15.37	2.93	12.54
12.99	2.00	67.92	15.39	2.82	11.98
13.02	2.01	68.10	15.41	2.80	12.29
13.05	2.02	68.00	15.40	2.89	12.39
6.82	1.21	72.50	12.53	2.85	14.61
6.72	1.20	72.51	12.72	2.82	14.49
6.77	1.19	72.48	12.68	2.84	14.53
6.80	1.19	72.50	12.69	2.89	14.49
18.88	2.64	12.24	12.83	2.90	14.66
19.10	2.65	12.22	12.88	3.15	24.30
19.00	2.66	12.21	12.79	2.95	14.38
19.10	2.65	12.23	12.80	2.92	14.58
13.95	3.29	12.70	12.50	2.91	14.77
14.10	3.33	12.71	12.53	2.98	14.66
13.90	3.30	12.70	12.61	2.92	14.82
13.97	3.31	12.75	12.59	2.96	14.70

Successive portions of air are taken into the burette of the Haldane and freed from oxygen and carbon dioxide until 10 ml. or less of nitrogen is in the burette. The volume of nitrogen required depends upon the suspected composition of the gas, the rule being that the volume of gas left at the end of an experiment after all absorbable gases have

been removed must be slightly more than 7 ml. in order to be read accurately.

TABLE III

Replicate analyses of gas samples containing Ether or Cyclopropane, nitrous oxide, CO_2 and Oxygen for their O_2 content only

Sample 1 O_2 per cent	Sample 2 O_2 per cent	Sample 3 O_2 per cent	Sample 4 O_2 per cent
50.20	55.21	61.20	70.32
50.20	55.21	61.20	70.32
50.00	54.98	60.97	69.89
50.25	55.06	60.49	70.20
50.50	55.20	61.00	70.21

When less than 3 ml. of nitrogen are required, it can be prepared and stored at once over pyrogallol. If more than this is required, it has to be stored in measured amounts over the sulphuric acid and finally transferred to the pyrogallol tube in the following manner. The volume of nitrogen prepared is measured and about 2.5 ml. are stored in the sulphuric acid tube. The volume of gas remaining in the burette is measured again, in order to determine accurately the amount stored. When this manœuvre has been repeated a sufficient number of times and the volume (V) of the residual gas in the burette has been noted, the nitrogen is transferred to the pyrogallol tube, leaving the level of sulphuric acid in the zero position. The Volume (v) of gas in the burette after bringing the level of NaOH to zero is then read. If the amount of nitrogen stored over sulphuric acid was V_{N_2}, the volume stored over pyrogallol will be $V_{N_2} - (V - v)$.

The gas sample is now introduced from a Barcroft tonometer or other gas reservoir into the burette in the standard manner. Ether and/or cyclopropane are absorbed

quantitatively by the concentrated sulphuric acid in the first absorbing tube; this step should be undertaken first. Carbon dioxide does not dissolve in this reagent and can be removed second. The remaining gas, consisting of nitrogen and oxygen, is then passed into the pyrogallol tube and the oxygen is absorbed. Readings of volume are obtained in the usual way and the volumes of gas absorbed by each reagent are computed from these figures.

The stored nitrogen is used during analysis whenever the volume of gas in the burette seems likely to fall below 7 ml. In this event the gas volume is first measured in the usual way; nitrogen is then transferred in suitable amount, about 2 ml., to the gas in the burette. A second volume reading is then taken in order accurately to measure the volume of added nitrogen. When the absorption in progress is complete and this final volume read, the volume of added nitrogen is subtracted before calculating the volume of gas absorbed.

It should be noted that nitrous oxide is fairly soluble in concentrated sulphuric acid and the presence of this gas introduces a serious inaccuracy into the estimation of ether and cyclopropane, if these are present as well. An approximate estimate of the amount of N_2O present may be made, however, by observing the rate of absorption of gas after passing the mixed gases 30 times over the sulphuric acid when all the ether has been absorbed. Figure 2 shows the principle of this method; the first part of the curve rising steeply is due principally to the absorption of ether (or cyclopropane), the second represents the rate of solution of nitrous oxide, each expressed in ml. per passage over the sulphuric acid; extrapolation of the graph, by means of the line joining the volume readings at 30 and 40 passages over sulphuric acid, cuts the zero ordinate at a point near

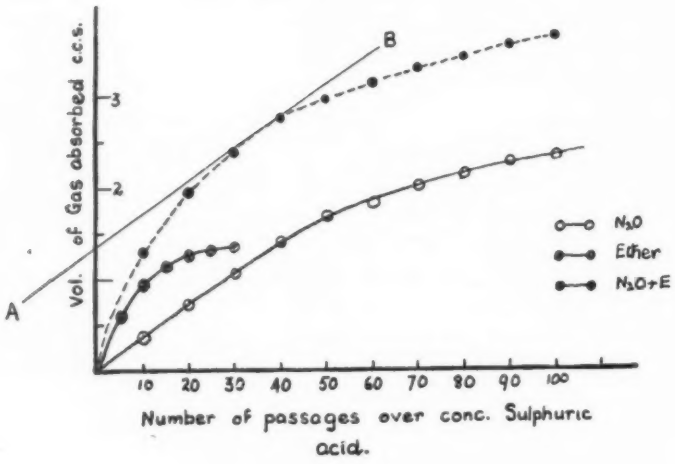


FIG. 2

The uppermost curve shows observations of gas volume taken during the analysis of an ether-nitrous oxide mixture. The middle curve shows the rate of absorption of the ether only and the lowest one the rate of absorption of the nitrous oxide. The use of the facts shown here is explained in the text.

the volume of ether absorbed. Clearly, the rate of absorption of the nitrous oxide will not always correspond with that shown in the graph (Fig. 2). Its slope will depend upon the vapour pressure of nitrous oxide in the mixture. The point is that extrapolation, between the two points on the graph indicated, does give a fair idea of the rate of absorption at this stage no matter what the vapour pressure is, since the rate of absorption up to thirty passages over the sulphuric acid is very nearly linear. The reproducibility and order of accuracy obtainable by this method are shown by the results shown in Table IV. The sulphuric acid should be changed between successive analyses carried out in this way in order to assure that nitrous oxide is absorbed in a

predictable manner. The change is easily made in the apparatus shown.

TABLE IV

Showing replicate determination of ether content of two samples made up manometrically to contain stated amounts of ether and nitrous oxide

Amount of ether in sample %	Amount of ether estimated %	Difference in percentage
12.0	12.1	0.1
12.0	11.1	0.9
12.0	12.2	0.2
12.0	10.9	1.1
10.0	9.8	0.2
10.0	9.4	0.6
10.0	11.1	1.1
10.0	10.0	0.0

EXAMPLE

The following is an example showing the progress of a typical analysis of a mixture containing air, ether, CO_2 and oxygen.

		ml.
Vol. of N_2 stored over sulphuric acid		2.219
		2.010
		4.229
Reading of burette before transferring to pyrogallol tube		7.000
Reading of burette after transfer		7.010
∴ Vol. of nitrogen stored over pyro		
4.229 − (7.010 − 7.000)	=	4.219

	ml.	ml.	
1. Volume of sample	= 8.880		
2. Vol. after extraction of most of the ether	= 7.250		
3. Vol. after adding stored nitrogen	= 9.300		
Vol. of added nitrogen		2.050	
4. Vol. after extraction of all the ether	= 9.120		
5. *Less* added nitrogen	= 7.070		
Vol. of ether extracted (1) – (5) (8.880 – 7.070) ml.	= 1.810		= 22.4 per cent
6. Vol. after extraction of CO_2	= 8.950		
Vol. of CO_2 extracted (4) – (6) (9.120 – 8.950) ml.	= 0.170		= 1.9 per cent
		ml.	
7. Vol. of remainder of stored nitrogen		4.219	
		less 2.050	
		2.169	
8. Vol. of residual gas	= 7.105		
9. *Less* remainder of stored nitrogen	= 4.936		(8)–(7)
∴ Vol. of O_2 absorbed (6) – (9) (8.950 – 4.936) ml.	= 4.014		= 45.5 per cent

Note. In this case nitrogen need not have been added during absorption of ether.

SUMMARY

A method is described whereby samples of anæsthetic gases may be analysed for their oxygen content. The amounts of ether and cyclopropane present may also be determined accurately in the absence of nitrous oxide. In the presence of that gas the determinations of ether and cyclopropane are less reliable.

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DEATHS UNDER STOVAINE: A CRITICISM

By E. FALKNER HILL

IN the *British Medical Journal*, April 22, 1950, two deaths immediately following the injection of 2 ml. of Stovaine were reported (Walker and Mathews, 1950) from the department of Obstetrics and Gynæcology, University College, Ibadan, Nigeria, West Africa. It is quite obvious that the deaths were directly due to the anæsthetic. In both cases death followed immediately on the administration of 2 ml. of amylocaine hydrochloride and before the operation had begun. Various measures for resuscitation were carried out but unsuccessfully. In the order given they were: (1) ephedrine grain $\frac{3}{4}$ (50 mg.); (2) adrenaline, 8 min.; (3) an intra-cardiac injection of 1 ml. of nikethamide, and also anal stimulation. "Despite these measures and artificial respiration there was no response." If that was the order in which these measures were carried out, of course there would be no response. A spinal anæsthetic has no direct effect on the heart so why stimulate it? It does paralyse respiration if it goes too high, and it is quite obvious that the Stovaine did go too high. Nothing is said about the position of the table, but if the patient were in the Trendelenburg position and if the Stovaine solution were of the hyperbaric variety these two factors would account for the extreme rapidity of the deaths.

The proper treatment for cases of this sort is to have a skilled anæsthetist to give the anæsthetic, for it is more important who gives the anæsthetic than what is given. Nevertheless, with this proviso in mind, it may serve some

useful purpose to discuss the relative merits of the drugs used and the exact procedure to be adopted if, as may happen to anyone, the life worthiness of the patient has been overestimated. This estimation of the life worthiness of a patient is the most difficult problem that any of us ever meet and one on which physician, surgeon and anæsthetist alike at times fall down.

Stovaine has a number of undesirable qualities; it is irritant and shows a much greater tendency to cause fainting and collapse, possibly due to the fact that it acts on the motor fibres before the afferents. It is not used as much as formerly. What of nupercaine and amethocaine? Professor Sebrechts, a very great authority on spinal anæsthesia as the result of long experience with cocaine, Novocaine, Stovaine, Tutocaine, Tropococaine, and nupercaine, prefers light nupercaine. He does not like heavy nupercaine; he thinks that it causes too many headaches. This is what he says about light nupercaine (Sebrechts, 1934).

1. " The factor which characterizes it and gives it an entirely special place in the series of anæsthetic agents is the intensity and duration of the blockage of the motor fibres."

2. " This [paralysis of all the intercostal nerves] is a condition frequently seen when one uses Percaine, which, as we have said, seems to have a special affinity for the motor fibres."

3. " In such cases the patient exhibits that slight degree of cyanosis which is so characteristic of Percaine anæsthesia."

4. " The suppression of the inspiratory movements of the thorax immediately causes the stoppage of the aspiration of the venous blood, and the action of the heart weakens. This is how the diminution of the respiratory amplitude is a cause of hypotension."

5. " The anæsthetic agent which blocks the anterior roots

of a high segment of the medulla [probably meaning spinal cord?] puts out of action not only the motor fibres, but also those of the vaso-constrictor orthosympathetic nerves which accelerate the heart and promote adrenalin secretion."

I submit that every one of these statements is a good reason for *not* giving nupercaine and particularly the light solution, at any rate to cases for Caesarean section.

The evidence before us to-day is to the effect that a spinal anæsthetic can cause the death of a reasonably healthy patient only by paralysing respiration. It is perhaps doubtful if all authorities would go so far, but what is not in doubt at all is that all agree that the paralysis or even the weakening of respiration is a serious event in the course of a spinal anæsthesia, one that demands immediate counter-measures. It is a fair thing, then, to take as the criterion or test of a technique of spinal anæsthesia, the effect of that technique on respiration. If we apply this test to nupercaine what do we find? An anæsthetic that occupies an entirely special place amongst anæsthetics by reason of " the intensity and duration of its blockage of the motor fibres ", in the course of the use of which we frequently find paralysis of all the intercostal muscles, which paralysis, " so frequently seen when one uses Percaine," is the cause of that diminution of amplitude of respiration which the professor cites as the cause of hypertension; an anæsthetic whose hall-mark is " a slight degree of cyanosis ". Please note that these are the statements of an enthusiastic user of nupercaine. But if the weakening and paralysis of respiration is the chief danger which we wish particularly to avoid, more especially when respiration is already embarrassed, then nupercaine is peculiarly unsuitable.

Amethocaine on the other hand has none of these disadvantages. Its action is not characterized by " a slight

degree of cyanosis "; the brunt of its power falls on posterior roots and because of this it does not paralyse the upper vaso-constrictors, only the lower intercostal muscles; it has therefore a very trifling effect on respiration or on the blood-pressure. These characteristics would seem to indicate that it is the more suitable anæsthetic for Cæsarean sections. The one advantage that nupercaine has over amethocaine is that it lasts longer; that advantage is irrelevant in the matter of Cæsarean sections.

In the correspondence which followed, O'Driscoll (1950) suggests that the excellent results published by Rufus Thomas (1942) were due to his use of heavy nupercaine. I would suggest that they were obtained in spite of its use, though, for obvious reasons, a heavy solution is better than a light one. Knowles (1950) suggested that the cause of the collapse was due to the Stovaine having got into the blood-stream. The chances are that if the Stovaine had got into the blood by mistake both patients would still be alive. 300 mg. procaine injected intravenously in the course of ten minutes influences neither the blood-pressure nor respiration. If procaine is injected into the jugular vein of a cat at the rate of 7.5 mg. per minute, it takes 24 minutes or 180 mg. to paralyse the cat's respiration, whereas 10 mg. injected into the cisterna magna will paralyse the respiration in 1½ minutes. Professor Sebrechts says, " The injection into a vein of 20 cc. of Percain solution 1: 1,500 without adrenalin causes no disquieting symptoms whatever." If the intravenous injection of these quantities of procaine and nupercaine cause no disquieting symptoms whatever, it is unlikely that the injection of 2 ml. of Stovaine would have had such a dramatic effect.

As regards restorative measures, first comes artificial respiration, an intratracheal tube with oxygen inflation of

the lungs at once, and 10 degrees Trendelenburg; only subsequent to these have you time for intravenous injections of ephedrine, etc. Timely and efficient artificial respiration will always save a cat and prolong its life till the effect of the anæsthetic has passed off. In the operating theatre it is often applied too late and not efficiently. There are cases so ill with advanced diabetes or uræmia, that any interference will precipitate a fatal issue but, if artificial respiration is applied in time and efficiently, even an advanced uræmic can be saved for the time being.

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THE FATE OF EUFAME MacCALZEAN

By M. H. ARMSTRONG DAVISON

IT has been stated that a certain Eufame MacCalzean or McAlyane (Gwathmey, 1914; Keys, 1945) was executed in Scotland in the reign of James VI for attempting to relieve the pains of childbirth. Such a bald statement is misleading, and the more important events which led to her trial and execution deserve some attention. These events are set out in a contemporary pamphlet, printed in 1591 and entitled " Newes from Scotland " (Anon, 1591), the title-page and a woodcut from which are here reproduced (Figs. 1 and 2).

In October 1589, James VI, throwing off his more customary cowardice, braved the terrors of the deep in order to voyage to Norway and bring back his bride, 15-year-old Anne of Denmark. The return journey was made in May of the following year, but the King's ship was beset by storms and there was some danger of shipwreck.

The disclosures of a girl suspected of witchcraft led to the arrest of numerous persons for having been involved in Satanic rites at the Kirk of North Berwick, whither they had sailed in sieves. The Devil attended the church in person and, after a lewd penance had been enjoined, urged the witches to attempt the destruction of the King. Various attempts by poison and witchcraft were made without success, and the witches eventually took a cat, christened it, tied parts of a dead man to it, and then deposited it in the sea off Leith, having sailed thither in their sieves for this

Newes from Scotland,

Declaring the Damna-

ble life and death of Doctor Fian, *a*
notable Sorcerer, who was burned at
Edenbrough in Ianuary laſt.
1591.

Which Doctor was regeſter to the Diuell
that ſundry times preached at North Bar-
rick Kirke, to a number of noto-
rious Witches.

With the true examinations of the ſaide Doctor
and Witches, as they vttered them in the pre-
ſence of the Scottiſh King.

Diſcouering how they pretended
to bewitch and drowne his Maieſtie in the Sea
comming from Denmarke, with ſuch
other wonderfull matters as the like
hath not been heard of at
any time.

Publiſhed according to the Scottiſh Coppie.

AT LONDON
Printed for William
Wright.

FIG. 1
Title-page, *Newes from Scotland*, 1591.

FIG. 2

Woodcut from *Newes from Scotland*, 1591.

Top left: The shipwreck.
Top right: The witches prepare the spell.
Bottom left: Satan preaching in the Kirk at North Berwick.
Centre: The congregation: Dr. Fian acts as stenographer.

purpose. This resulted in the springing up of a great storm which sank at least one boat and imperilled the King's ship.

Many of the accused witches, having confessed their crimes under torture, were executed by strangling, their bodies being afterwards burned. One who did not confess was Euphemia MacCalyean (*z* is often written for *y* in old Scots manuscripts). This lady was the daughter of Thomas MacCalyean, Lord Cliftonhall, a Senator of the College of Justice and a man distinguished for his erudition and attainments. He had died ten years before these events, having incurred the dislike of the Queen Regent, Mary of Guise, for his spirited defence of the rights of Edinburgh.

Roughead (1919) states of the fair Euphemia that the offences with which this lady was charged are no less astonishing than varied. They embrace the attempted poisoning of her husband in the first year of her marriage to the end that she " mycht gett ane utheir guidman ", as a result of which he " brak out in reid spottis " and was compelled to seek safety in France, his disappointed spouse bidding " the ffiend ga with him "; bribing with her own jewels her daughter's lover to transfer his affections to herself, and, on his declining either to do so or to return the gifts, attempting to recover these by witchcraft; destroying by the same means several persons, including her father-in-law; and, finally, participating in " the Conventicle at North-Berwick Kirk ".

From Pitcairn (1833), we learn that Ewfame Makcalyane *alias* Moscrop (her married name) was tried on June 9 to 12, in the twenty-fourth year of James VI. The dittay, or indictment, included twenty-eight counts, all concerning witchcraft and some being for murder as well. The eighteenth count reads thus: " Indicted of consulting and seeking help of the said Annie Sampson, a notorious witch,

FIG. 2

Woodcut from *Newes from Scotland*, 1591.

Top left: The shipwreck.
Top right: The witches prepare the spell.
Bottom left: Satan preaching in the Kirk at North Berwick.
Centre: The congregation: Dr. Fian acts as stenographer.

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for relief of your pain in the time of your birth of your two sons, and the receiving from her to that effect a ' bordstane ' [presumably a stone with a natural hole in it and thus thought to have magical powers; a bored-stone] to be laid under the bolster, put under your head; enchanted mould [i.e. soil from a cemetery] and powder put in a piece of paper to be used and ' rowit ' [i.e. rolled] in your hair at the time of your ' droweis ' [i.e. birth pangs]; your ' guidman's ' [i.e. husband's] ' sark ' [i.e. shirt] to be presently taken of him and laid ' woumplit ' [i.e. rumpled] under your bedside; the which being practised by you as you had received the same from the said Annie. By the information and the use therof, your sickness was cast off you unnaturally in the birth of your first son upon a dog which ran away forthwith and was never seen again. And in the birth of your last son, the same practice aforesaid was used and your natural and kindly pain unnaturally cast off you upon the wanton cat in the house, which likewise was never seen thereafter."

The verdict of the assize (i.e. jury) was returned on June 12 by the chancellor (i.e. foreman), James Johnstone of Elphinstone, who was not " chased from the assize ", as is wrongly stated by Roughead (1919). In the " Articles of Conviction " (or verdict), she was found guilty on ten of the twenty-eight counts, the fifth reading: " Item, for consulting with Annie Sampson, a witch, for getting of moulds from her to be used by the said Effie in relief of her pain in her birth of her two sons."

The doom (or judgment) was passed on her on June 15, all her goods being forfeited to the crown and she herself sentenced to be " brunt in assis, quick " (i.e. to be burnt to ashes alive), without the humanity of previous strangling, which sentence was duly carried into effect on Castle Hill.

The above account reveals the prevalence of witchcraft 350 years ago. Belief in the powers of sorcerers was almost universal. King James VI (1597) himself wrote a highly authoritative book on the subject in which he expressly points out that to obtain good ends by witchcraft is a heinous sin. Even the most outwardly respectable were wont to resort to witches to obtain their ends and this was particularly brought to the notice of the world by the proceedings of the Chambre Ardente in Paris in the 1680s.

It was then shown that nearly all the great ones of the court of " Le Roi Soleil " were either actively engaged in poisoning and witchcraft or were the passive victims of these nefarious machinations (Johnson).

These proceedings likewise disclosed the traditional connexion between midwifery and witchcraft, of which more than a hint comes to us from the trial of the wretched Euphemia and her confrères.

Without in any way wishing to whitewash the justice dispensed by James VI, whose dealings with Arabella Stewart, Raleigh and Robert Carr speak for themselves, it is worth notice that Euphemia suffered the penalty of using witchcraft, and the real charge against her was of attempting the death of the King by her participation in the " Conventicle at the Kirk of North-Berwick ". No mention would have been made of her attempts at self-administered obstetrical analgesia, had they been undertaken by legal means; her use of witchcraft on these occasions, however, was a useful point for the prosecution, as showing that she did consort with known witches.

It therefore seems that the statement that she was done to death for attempting to allay the pains of childbirth is a terminological inexactitude, and we may rest content that, whatever the people of an enlightened age may think of

witchcraft and such barbarous punishment, Euphemia MacCalyean was a thoroughly vicious woman, whose death is not greatly to be mourned.

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Keys, T. E. (1945), *History of Surgical Anesthesia*, Schuman's, New York, p. 9.
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Roughead, W. (1919), *The Riddle of the Ruthvens and other stories*, Edinburgh, p. 225.

The following descriptions of new apparatus are sent to us by the Department of Anæsthesia, University of Durham:

ENDOTRACHEAL TUBE TRAYS

THE tray is home-made of $\frac{1}{8}$ inch Perspex, the base being 15 inches square, and it is divided into five troughs by curved Perspex divisions, 2 inches in height. It is convenient to keep one tray for cuffed and one for uncuffed tubes. When all the available tubes in one anæsthetic room are thus displayed, it is simple to select the most appropriate one for a particular case. (Fig. 1.)

HEIDBRINK FLOWMETERS

THE Oxygen Rotameter tube is often calibrated up to 2,000 ml. per minute. Quantities in excess of this amount can only be given by guesswork. To overcome this difficulty, a Heidbrink oxygen flowmeter has been inserted in series between the oxygen supply and the rotameter. To avoid confusion, the entire oxygen-helium scale (on the left-hand side of the flowmeter) and the oxygen scale below 2 litres per minute have been painted out. Flows less than 2 litres per minute are measured on the rotameter and higher quantities are read from the Heidbrink flowmeter. The Romac clips and nipples are of the standard oxygen size and are not interchangeable with the carbon dioxide and nitrous leads. In the illustration, the by-pass has been opened and a flow of 9 litres of oxygen per minute is passing. The rotameter bobbin can be seen at the top of the tube. (Fig. 2.)

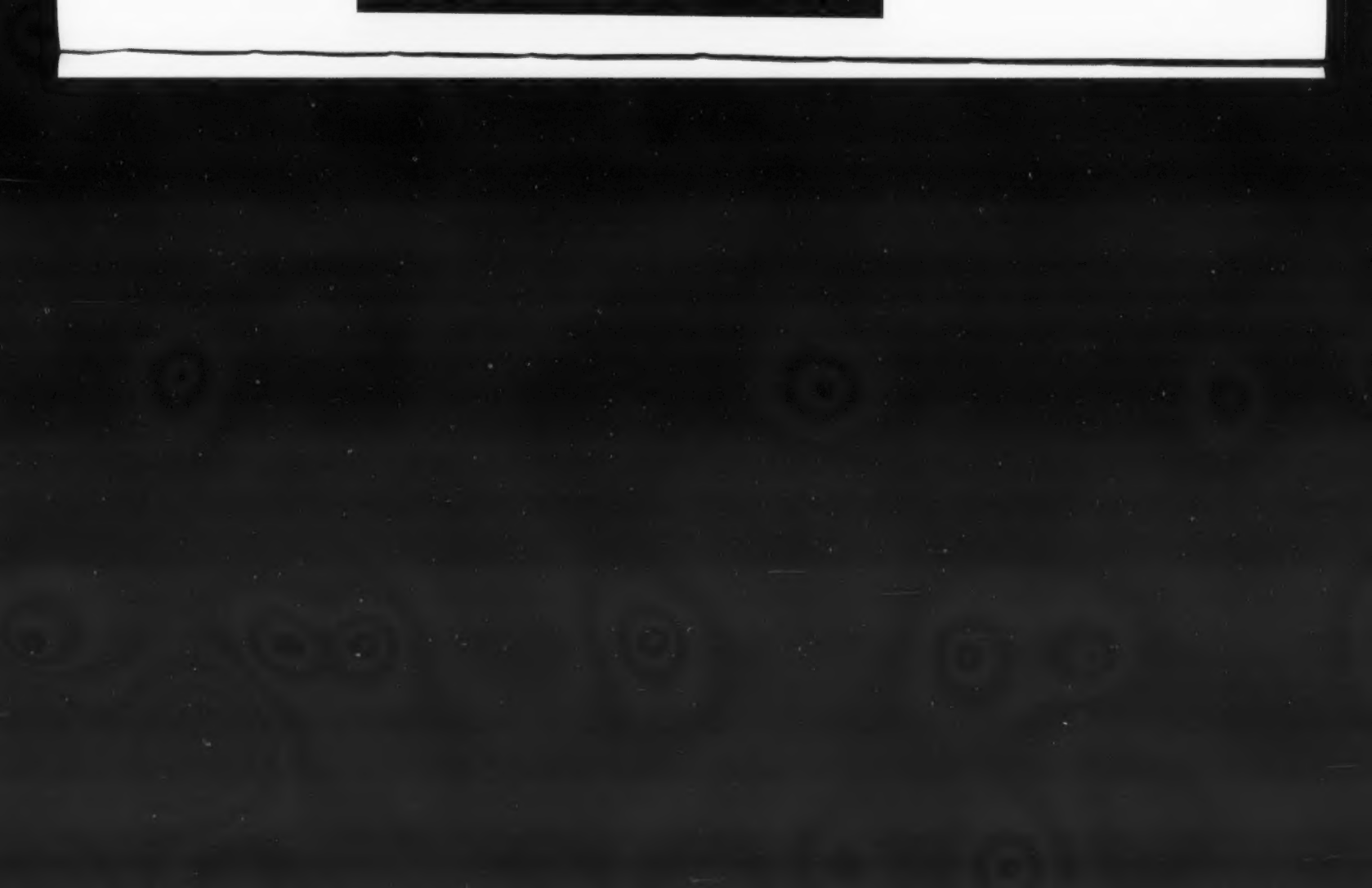
CHEST SUPPORT FOR PATIENTS IN THE LATERAL POSITION

THE support is home-made of heavy dural, 6 inches wide. The cross-piece which is inserted under the operating table cushion is 19½ inches long and extends the full width of the table. It is separated from the upper cross-piece by 1¼ inches, which leaves room for the canvas stretcher, etc. The upper cross-piece is 10½ inches long, a little more than half the width of the table. The upper part of the front of the patient's chest rests against the upright, which is 9 inches long and which should be padded. He is held in position by the weight of the dependent upper arm and his weight holds the support in place. The support must not be placed so far up the chest that the top edge of the upright presses into the axillary fold. The principle is the same as the chest support used in thoracic surgical units, but can be used on any type of operating table. (Fig. 3.)

COLOURED MOUTH-PACKS

WHEN gauze is used by anæsthetists for packing the pharynx, there is always a risk that a discarded pack may be included in the surgical mop count. For this reason, a coloured pack has been advocated. The colouring material must be non-toxic and must still make the pack distinctive even when the latter is completely saturated with blood. Packs dyed with a solution of methylene blue and then dried are satisfactory. They lose only little of the dye on wetting and remain distinctive even when soaked in blood.

If coloured mouth-packs be introduced, the anæsthetist must be extremely careful that he never uses an undyed mouth-pack.



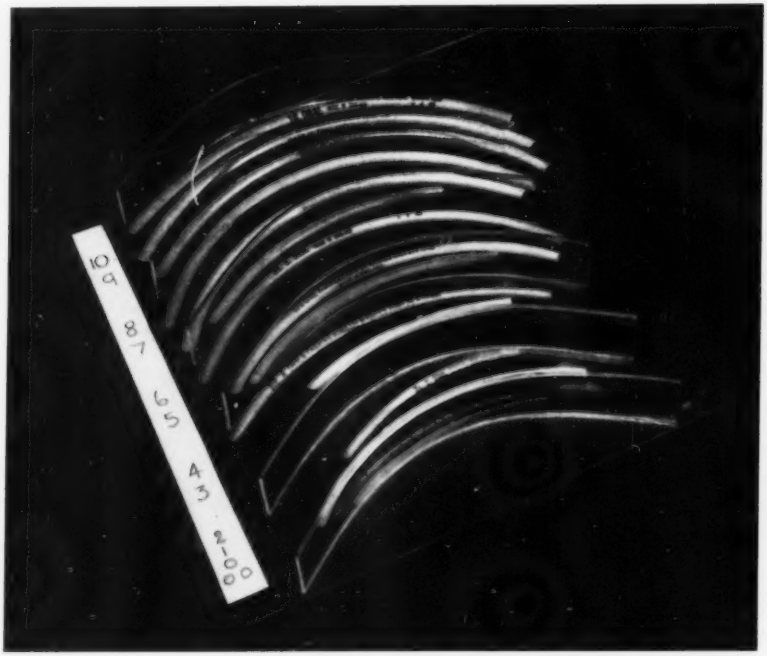


FIG. 1
Perspex Endotracheal Tube Tray

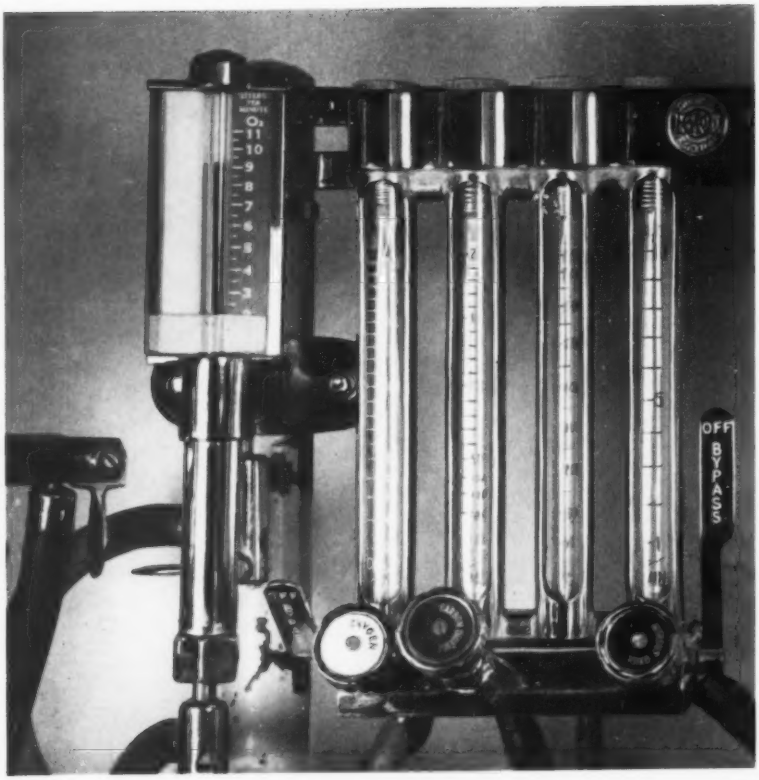


FIG. 2
Heidbrink Oxygen Flowmeter in series with Rotameter

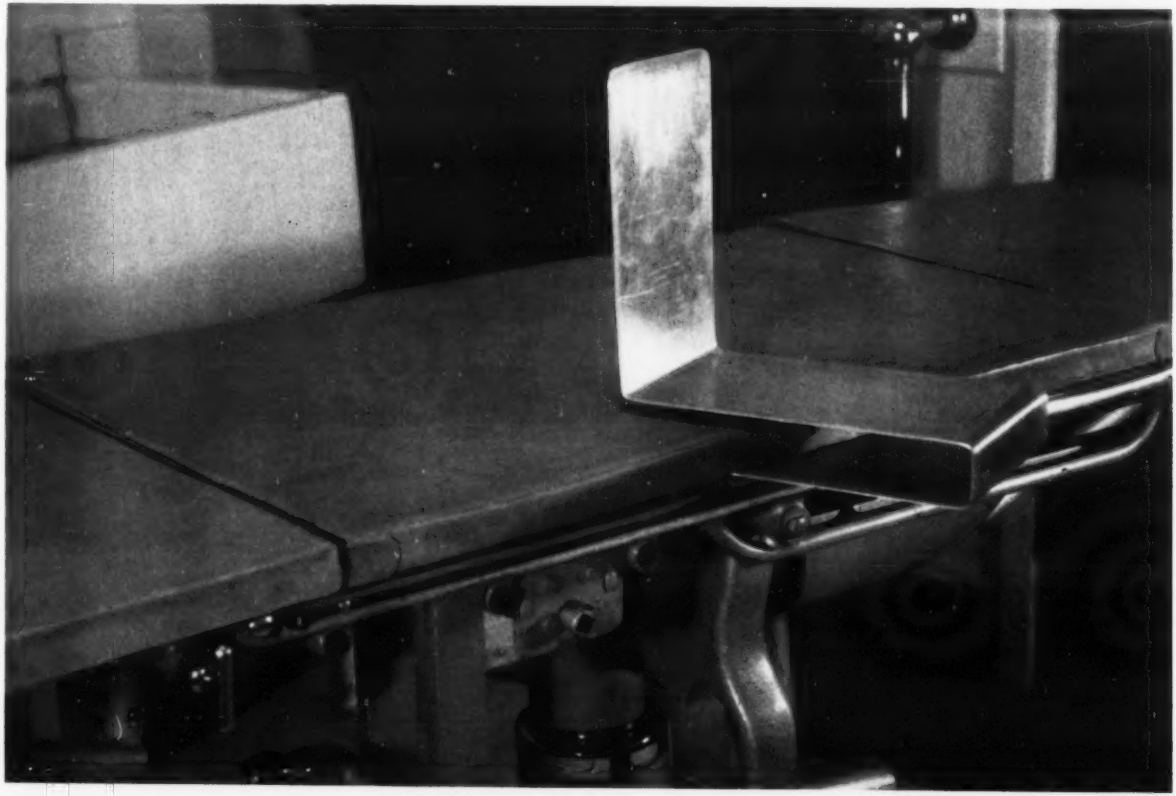
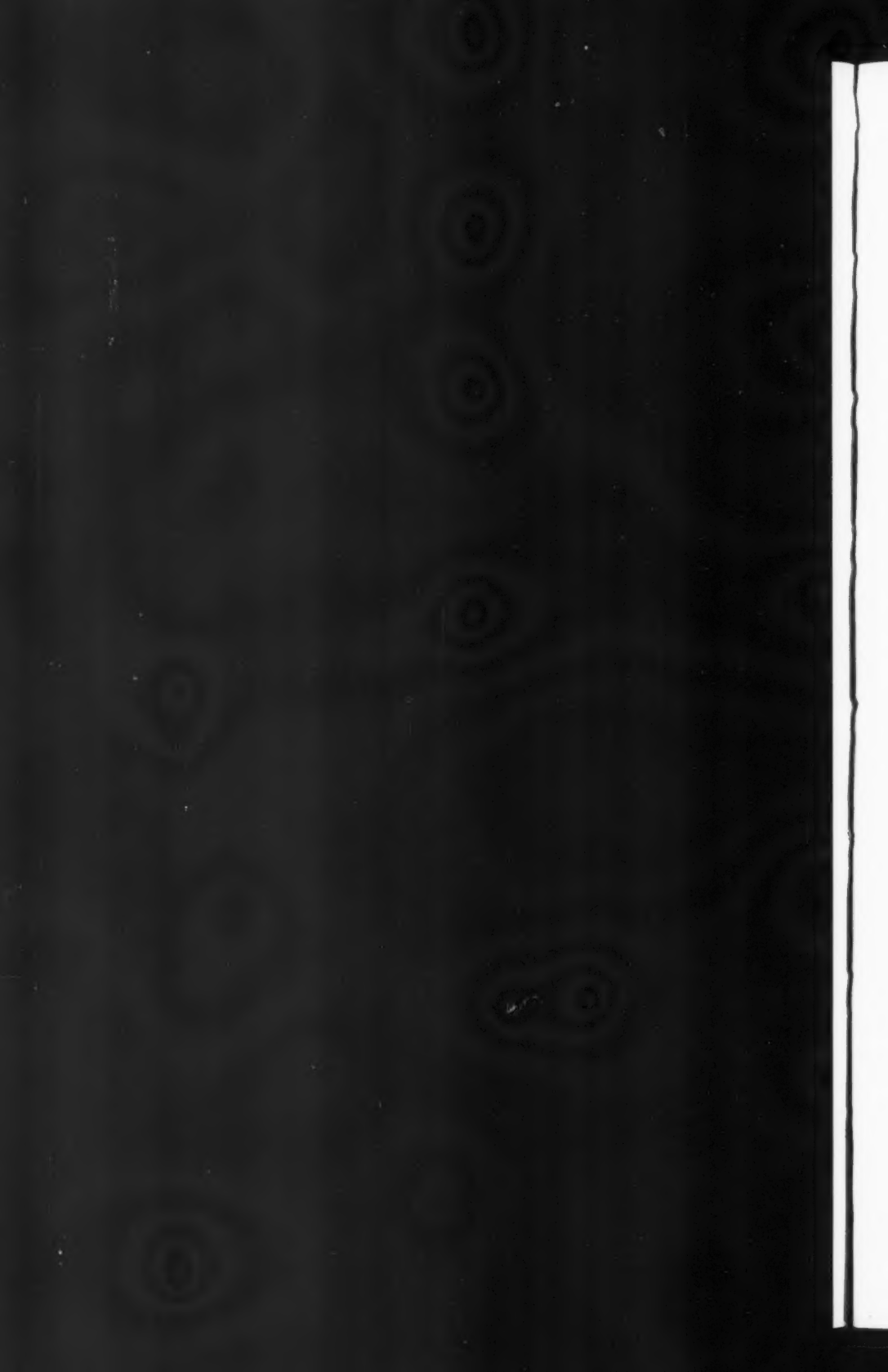


FIG. 3
Chest Support for Patient in Lateral Position

FIG. 4
Flowmeter–Humidifier



AN OXYGEN FLOWMETER-HUMIDIFIER FOR THE RESUSCITATION OF INFANTS

THIS flowmeter-humidifier (Fig. 4) has a safety valve which prevents the building up of pressure, a point of importance in the resuscitation of infants when oxygen is being administered by catheter. The inlet tube is so perforated that, with the bottle filled with water to the correct level, bubbles appearing in a continuous stream from the side, but not from the open bottom of the tube, indicate a flow-rate between $1\frac{1}{2}$ and 4 litres per minute, i.e. a flow which will be adequate but not excessive in all cases.

In addition to the outlet tube, the cork is pierced by a Perspex chimney, 2.5 cm. in diameter and about 20 cm. long, which extends 8 mm. below the water level. If the outlet be obstructed, the gas-pressure forces water up the chimney for a distance of about 8 cm., when the water level falls below the bottom of the chimney and gas escapes up it. It is thus impossible to deliver oxygen at a pressure of more than 8 cm. of water. (Fig. 5.)

The chimney is used for filling the bottle with water, and its height prevents water from being spilled when the safety valve is in action.

Drs. W. W. Mushin and D. Ezard (Cardiff) make the following suggestions:

THE RESERVOIR BAG IN A DIFFERENT POSITION

THE illustration (Fig. 6) shows a device used for bringing the reservoir bag from its usual position down to the level

of the top of the anæsthetic table. By doing this the breathing tube no longer sweeps across the table-top and the utility of the latter is much increased.

The device is made by Medical & Industrial Equipment Ltd., of 12 New Cavendish Street, London, W.1.

THE CARDIFF REMOTE CONTROL EXPIRATORY VALVE

THIS assembly (Fig. 7) was invented to enable the expiratory valve on a continuous-flow apparatus to be closed from a distance—a need we have felt during such operations as craniotomy, when artificial respiration by squeezing the bag may have to be done at a moment's notice. The valve consists of the usual disc and light spring, and closure is effected by a Bowden wire mechanism actuated by a lever clamped near the reservoir bag. The valve may also be closed if desired by means of a press-button situated on the valve body itself.

The complete valve may be obtained from Medical & Industrial Equipment Ltd., 12 New Cavendish Street, London, W.1.

FIG. 5
Flowmeter-Humidifier, outlet obstructed and safety valve in action

FIG. 6
Breathing bag.

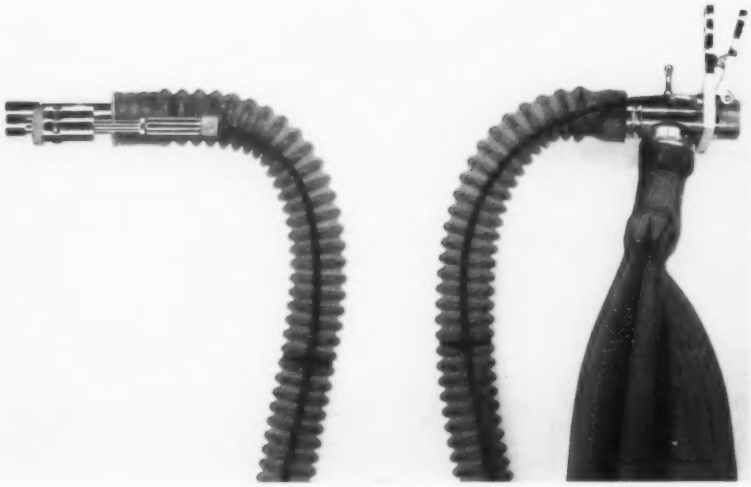
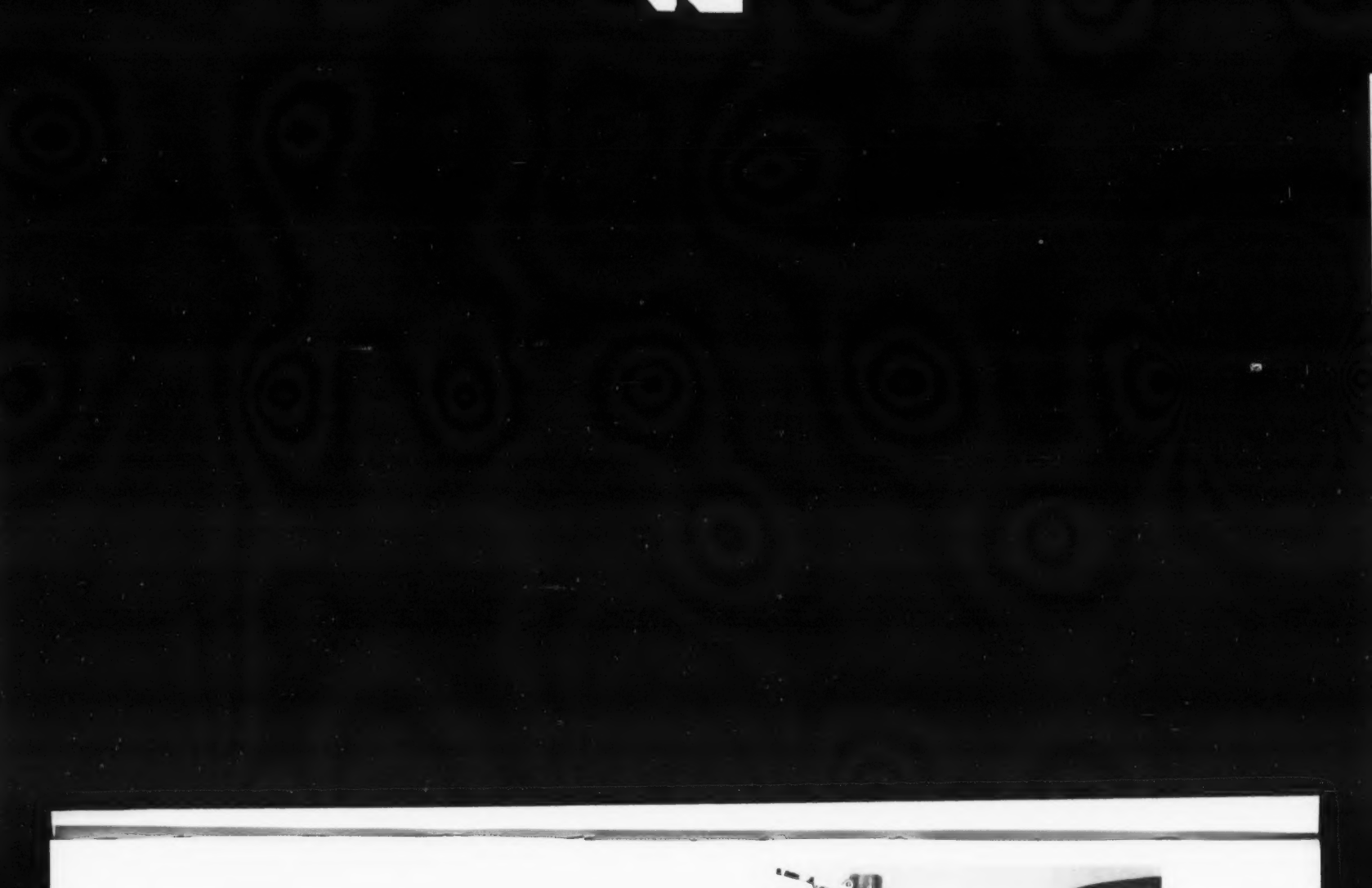


FIG. 7
Cardiff Remote Control Expiratory Valve



REVIEW

Aspects Actueles de L'Anesthesiologie. By MARCEL-J. DALLEMAGNE. Published by Masson et Cie, Paris. Price 1650 francs.

This is an excellent book. It is well arranged, therefore easy to refer to; it is well printed, therefore easy to read; the diagrams are interesting and clearly labelled, rather an unusual but very desirable feature. There are no less than 555 references, so that it is a great help in following up a particular line. Every candidate for the D.A. would be well advised to study it, as it may provide a fountain from which not only students but also their seniors may drink.

The author holds very definite opinions, and as truth comes more easily out of error than out of confusion, the perusal of these opinions should be a step to truth. Dr. Dallemagne sets before himself three ends: (*a*) to teach, (*b*) to present the results of recent research with the necessary references, and (*c*) to stop the use of chloroform as an anæsthetic.

In a short review of this sort there is space only to mention three points. To take the last first, the last word has probably not been said on the question of chloroform. Although it is customary and popular just now to run it down, it is strange that so many millions of patients have come through an operation safely under chloroform, if it is as dangerous as the author would have us believe. Death on the table under chloroform is due to inattention on the part of the anæsthetist, if he is an expert, and due to ignorance if he is not. With atropine as premedication, an open airway and a free supply of oxygen, the risk of chloroform

is reduced to a minimum. Dr. Dallemagne suggests that the best death rate we can expect is one in four thousand. That seems a generous estimate. One in two thousand five hundred is the more generally accepted figure. Dr. Ralph Waters, in a recent address, made the following observations. "I have come gradually to realize two facts: (*a*) relief from pain is purchased always at a price, and (*b*) the price in both morbidity and mortality does not greatly differ whatever the agent or agents used. About one patient in one thousand subjected to surgical operation dies before leaving the theatre regardless of the drugs used." These opinions from the protagonist of cyclopropane are directly contrary to those of Dr. Dallemagne, and so it must be concluded that the controversy is not yet settled.

Dr. Dallemagne says, "L'Atropine est un excitant respiratoire léger et aux doses ordinairement employées, elle stimule le centre du vague." This, though true, must not blind us to the well-known fact—and more important action of atropine—that it paralyses the vagal terminations in the heart.

On spinal anæsthesia, he quotes Babcock with approval, namely, "The dangers of spinal anæsthesia depend more on he who uses it than on the product used." He adds, "Elle ne présente ni plus ni moins de dangers que n'importe quel mode d'anesthésie, mais elle réclaime de la part de celui qui la pratique, encore plus de décision et d'intelligence que toute autre technique." A statement which it would be well to emphasize.

It is a most thought provoking book and this is one of the most desirable of qualities in a book on anæsthesia.